

AMENDMENT (IN RESPONSE TO OFFICE ACTION
DATED NOVEMBER 17, 2003)

CLAIM AMENDMENTS

1. (PREVIOUSLY AMENDED) A system of converting waste plastics into hydrocarbon oil, said system comprising:
 - (1) an oven thermal cracking reactor, into which solid waste plastics are fed and in which said waste plastics are cracked at a temperature in a range of 270-800°C to obtain a thermal cracking product of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
 - (2) a catalytic cracking portion coupled to receive said gaseous hydrocarbons, in which the gaseous hydrocarbons are cracked with an acidic catalyst;
 - (3) a cooling portion in which the gaseous hydrocarbons after the catalytic cracking are substantially converted into liquid hydrocarbons of smaller molecules, and remaining non-convertible gaseous hydrocarbon substances are transported back to compensate the heating of the thermal cracking reactor; and
 - (4) a tubular continuous thermal cracking and residual discharging portion being connected to receive the mixture of liquid hydrocarbons and residues from said thermal cracking reactor,

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such that the liquid hydrocarbons are gradually thermally cracked into gaseous hydrocarbons when passing through the tubular continuous thermal cracking and residual discharging portion, while the dry residues from the previous thermal cracking and residues generated from the further thermal cracking are discharged at a residual discharge outlet of the continuous thermal cracking and residual discharging portion.

2. (PREVIOUSLY AMENDED) The system of claim 1, further comprising a hydrochloric acid removal portion connected before the catalytic cracking portion to receive the gaseous hydrocarbons, respectively, from the thermal cracking reactor and from the continuous thermal cracking and residual discharging portion, in which the gaseous hydrocarbons are subject to reaction with an alkaline metallic substance at a high temperature; said catalytic cracking reactor being connected to said hydrochloric acid removal portion to receive the chlorine-free gaseous hydrocarbons and having said gaseous hydrocarbons subjected to catalytic cracking with said acid catalyst.

3. (CURRENTLY AMENDED) The system of claim 1, further comprising a pressurized activating reaction portion provided to receive said liquid hydrocarbons from the cooling portion to solidify [few amount of] sulfur, nitrogen, and phosphorus contained in said liquid hydrocarbons so as to

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obtain purified hydrocarbon oils.

4. (CURRENTLY AMENDED) The system of claim 1, wherein said continuous thermal cracking and residual discharging portion comprises a plurality of sets of [reacting] reaction tubes [parallel] arranged in parallel with one another, in which screw conveyors are provided, each screw conveyer rotating in an opposite direction with the rotation of adjacent screw conveyors such that the mixture of liquid hydrocarbons and residues is pushed continuously forward from the beginning of the tubes to the end of the tubes, while all of the liquid hydrocarbons are gasified, and the residues are discharged from a residual discharging outlet.

5. (CURRENTLY AMENDED) The system of claim 2, wherein said hydrochloric acid removal action is carried out at a temperature of 270-800°C, chloride ion being replaced from [hydrochlorides] hydrochloric acid contained in said gaseous hydrocarbons and the resulting chlorine gas being expelled out of the hydrochloric acid removal portion.

6. (CURRENTLY AMENDED) The system of claim 1, wherein said cooling portion comprises three stages, through which most of the catalytically cracked gaseous hydrocarbons are converted into liquid hydrocarbons, while certain gaseous hydrocarbons that are non-convertible at room temperature and pressure are [collected] collected and transported

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back to compensate the heating capacity of the thermal cracking.

7. (PREVIOUSLY AMENDED) A system of converting waste plastics into hydrocarbon oil, said system comprising:

- (1) an oven thermal cracking reactor, into which solid waste plastics are fed and in which said waste plastics are cracked at a temperature in a range of 270-800°C to obtain a thermal cracking product of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
- (2) a catalytic cracking reactor being connected to receive the gaseous hydrocarbons and having said gaseous hydrocarbons subjected to catalytic cracking with an acid catalyst;
- (3) a cooling portion in which the gaseous hydrocarbons after the catalytic cracking are substantially converted into liquid hydrocarbons of smaller molecules and remaining non-convertible gaseous hydrocarbon substances;
- (4) a tubular continuous thermal cracking and residual discharging portion being connected to receive the mixture of liquid hydrocarbons and residues from the thermal cracking reactor, in which the liquid hydrocarbons are gradually and cracked into

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gaseous hydrocarbons when passing through the tubular continuous thermal cracking and residual discharge portion, while the dry residues from the previous thermal cracking and residues newly generated from the further thermal cracking are discharged at a residual discharge outlet of the continuous thermal cracking and residual discharge portion; and

(5) a hydrochloric acid removal portion being connected to receive the gaseous hydrocarbons, respectively, from the thermal cracking reactor and from the continuous thermal cracking and residue discharging portion.

8. (CURRENTLY AMENDED) The system of claim 7, wherein a pressurized activation reaction portion is provided to receive the liquid hydrocarbons from the cooling portion to solidify sulfur, nitrogen, and phosphorus contained in the liquid hydrocarbons so as to obtain purified hydrocarbon oils.

9. (CURRENTLY AMENDED) The system of claim 7, wherein the thermal cracking and residual discharging portion comprises a plurality of continuous reacting tubes of parallel arrangement, and screw-propelling conveyors mounted inside the tubes, wherein the mixture of the liquid hydrocarbons and residues is pushed forward by said screw conveyors, and passes through

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the [reacting] reaction tubes, while the mixture is maintained at a high temperature sufficient to enable complete gasification of the liquid hydrocarbons.

10. (PREVIOUSLY AMENDED) The system of claim 7, wherein, in said hydrochloric acid removal portion, the thermal cracking products is in reaction with alkaline substances to replace the chlorine from the hydrochloric acid contained in the thermal cracking resultants so as to obtain purified gaseous hydrocarbons, and the hydrochloric acid removal reaction is carried out at a high temperature in a range of 270-800°C.

11. (CURRENTLY AMENDED) The system of claim 7, wherein the cooling portion comprises three stages of cooling, whereby the catalytically cracked gaseous hydrocarbons are substantially converted into [gaseous] liquid hydrocarbons of smaller molecules of eight to twenty carbon atoms, with gaseous hydrocarbon substances equal to or less than four carbon atoms remaining.

12. (PREVIOUSLY AMENDED) The system of claim 11, wherein said gaseous hydrocarbons become said liquid hydrocarbons through said three cooling stages, and said few gaseous hydrocarbon substances that are non-convertible at room temperature and pressure are returned to the thermal cracking reactor and continuous thermal cracking and residual discharge

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portion to compensate the heating supply for the thermal cracking reaction.

13. (PREVIOUSLY AMENDED) A method of converting waste plastics into hydrocarbon oil, said method comprising the following steps of:

- (1) feeding solid waste plastics into an oven thermal cracking reactor;
- (2) subjecting said solid waste plastics to thermal cracking at a temperature in a range of 270-800°C to obtain a thermal cracking product of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
- (3) passing said gaseous hydrocarbons into a catalytic cracking reactor for catalytic cracking with an acid catalyst;
- (4) sending said catalytically cracked gaseous hydrocarbons into a cooling portion to obtain liquid hydrocarbons of smaller molecules; and
- (5) said mixture of liquid hydrocarbons and residues from the thermal cracking portion being sent into a tubular continuous thermal cracking and residual discharging portion, in which the liquid hydrocarbons are gradually cracked into gaseous hydrocarbons when passing through the tubular continuous thermal cracking and residual discharge portion, while the dry residues from the

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previous thermal cracking and residues generated from the further thermal cracking are discharged at a residual discharging outlet of the continuous thermal cracking and residual discharge portion.

14. (CURRENTLY AMENDED) The method of claim 13, wherein [said] gaseous hydrochloric acid contained in said gaseous hydrocarbons from the thermal cracking reactor and the [continue] continuous thermal cracking and residual discharging portion are sent to a hydrochloric acid removal portion for removing hydrochloric acid from said gaseous hydrocarbons to obtain chlorine free gaseous hydrocarbons before said catalytic cracking.

15. (CURRENTLY AMENDED) The method of claim 13, wherein said liquid hydrocarbons obtained from the cooling portion are passed into a pressurized activation reaction portion in which sulfur, nitrogen, and phosphorus contained in the liquid hydrocarbons are solidified so as to obtain purified hydrocarbon oils.

16. (ORIGINAL) The method of claim 13, wherein said continuous thermal cracking in said continuous thermal cracking and residual discharging portion is carried out at a temperature range of 270-800°C.

17. (PREVIOUSLY AMENDED) The method of claim 14, wherein said hydrochloric acid removal reaction is carried out in presence of alkaline metallic substances at a temperature of 270-800°C.

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18. (CURRENTLY AMENDED) The method of claim 13, wherein said cooling is a three-stage cooling, through which most of the gaseous hydrocarbons are turned into liquid hydrocarbons, and gaseous substances that are not convertible at room temperature and pressure are returned to the thermal cracking reactor and the continuous thermal cracking and residual discharge portion to generate additional heating for the thermal cracking.

19. (ORIGINAL) The method of claim 15, further comprising a step of separation of hydrocarbon oils from the pressured activation reactor to obtain further purified hydrocarbon oils by means of a centrifuge.

20. (PREVIOUSLY AMENDED) A method of converting waste plastics into hydrocarbon oil, said method comprising the following steps of:

- (1) feeding solid waste plastics into an oven thermal cracking reactor;
- (2) subjecting said solid waste plastics to thermal cracking at a temperature in a range of 270-800°C to obtain a thermal cracking product of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
- (3) passing said gaseous hydrocarbons into a catalytic cracking reactor for catalytic cracking with an acid catalyst;

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- (4) sending said catalytically cracked gaseous hydrocarbons into a cooling portion to obtain liquid hydrocarbons of smaller molecules;
- (5) passing said mixture of liquid hydrocarbons and residues into a continuous thermal cracking and residual discharging portion, in which the liquid hydrocarbons are gradually cracked into gaseous hydrocarbons when passing through the continuous thermal cracking and residual discharging portion, while the dry residues from the previous thermal cracking and residues newly generated from the further thermal cracking are discharged at a residual discharging outlet of the continuous thermal cracking and residual discharge portion; and
- (6) sending said gaseous hydrocarbons from the thermal cracking reactor and from the continuous thermal cracking and residual discharging portion to a hydrochloric acid removal portion for removing [hydrochloride] hydrochloric acid from said gaseous hydrocarbons to obtain chlorine free gaseous hydrocarbons before said catalytic cracking.

21. (CURRENTLY AMENDED) The method of claim 20, further comprising a step of passing said liquid hydrocarbons from said cooling

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stage into a pressurized activation reaction portion to have sulfur, nitrogen, and phosphorus contained in the liquid hydrocarbons solidified so as to obtain purified hydrocarbon oils.

22. (CURRENTLY AMENDED) The method of claim 20, wherein said continuous thermal cracking is carried out in a plurality of continuous [reacting] reaction tubes of predetermined length parallel arranged at a temperature range of 270-800°C.

23. (CURRENTLY AMENDED) The method of claim 20, wherein said [hydrochloride] hydrochloric acid removal reaction is carried out in presence of alkaline metallic substances at a temperature range of 270-800°C.

24. (CURRENTLY AMENDED) The method of claim 20, wherein said catalytically cracked gaseous hydrocarbons are passed through three stages of cooling, such that most of the gaseous hydrocarbons are converted into liquid hydrocarbons of smaller molecules, while certain gaseous hydrocarbons that are not convertible at room temperature and pressure are led back the thermal cracking reactor and the continuous thermal cracking and residual discharge portion to compensate the heating capacity of thermal cracking.

25. (ORIGINAL) The method of claim 21, wherein the liquid hydrocarbon oils is subject to a separation process by means of a centrifuge.